REMARKS

Claims 1-14 are pending in the Application. Claims 12 and 13 are amended in this response. Claim 14 is new. The Examiner has rejected claims 1-13 under 35 USC §101 for lack of utility, asserting that none of the claims produce any "useful, concrete, or tangible" results. Applicants have carefully considered the Examiner's rejections. Applicants respectfully traverse and request reconsideration.

I.   Response to Rejections Under 35 USC §101

A.   Methodology for Determining Compliance With 35 U.S.C. §101

Before responding to the Examiner's rejection, it is appropriate to establish the methodology for determining compliance with 35 U.S.C. §101. According to the Federal Circuit, that methodology is a two-step process. In the first step, it is determined whether the claimed subject matter fits within one of the four categories enumerated in 35 U.S.C. §101, *i.e.*, is a process, machine, article of manufacture, or composition of matter. *See State Street Bank & Trust Co. v. Signature Financial Group, Inc.*, 149 F.3d 1368, 1372 (Fed. Cir. 1998). If so, then, in the second step, it is determined whether the claimed subject matter fits into one of the three recognized categories of unpatentable subject matter, *i.e.*, is a law of nature, natural phenomena, or an abstract idea.[1] *See AT&T Corp. v. Excel Communications, Inc.*, 172 F.3d 1352, 1355 (Fed. Cir. 1999). If the claimed subject matter fits into one of the four categories enumerated in 35 U.S.C. §101, and avoids the three recognized categories of unpatentable subject matter, it satisfies 35 U.S.C. §101.

**B.   Application of this Methodology to the Claims Here**

Claims 1-11 are plainly directed to a process. And claims 12-14 are plainly directed to an article of manufacture. *See In re Beauregard*, 53 F.3d 1583, 1584 (Fed. Cir. 1995) (computer readable medium an article of manufacture under 35 U.S.C. §101). Moreover, claims 1-14 are plainly not directed to a law of nature, *e.g.*, $E = MC^2$, or a natural phenomena. The only issue, then, is whether the claims are directed to an abstract idea wholly devoid of practical utility or are directed to concrete ideas having practical utility. *See State Street*, 149 F.3d 1373. The dividing

---

[1] These three categories of unpatentable subject matter are *exclusive*, as there is no independent mathematical algorithm or business method exception to patentable subject matter. *See AT&T*, 172 F.3d at 1356; *State Street*, 149 F.3d at 1375.

line between when the claims are directed to an abstract idea wholly devoid of practical utility and a concrete idea having practical utility depends on whether the claims produce a useful, concrete, and tangible result. *Id.*

Here, the claims transform data representing the vertices of an n-sided polygon into weights (called barycentric coordinates) that define an interior point of a polygon **P** in terms of its vertices. Referring to Figure 2 of the subject application, reproduced below,
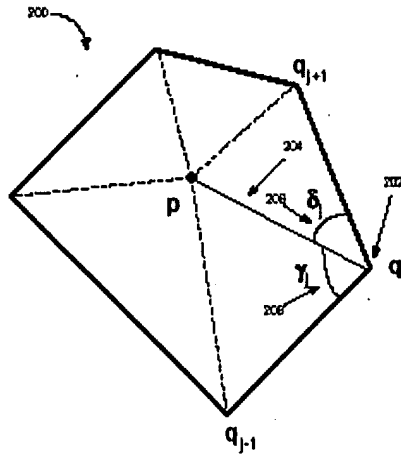
a weight w_j, corresponding to the vertex q_j, is determined based solely on the length of the edge pq_j, and the two adjacent angles δ_j and γ_j, in accordance with the following formula:

$$w_j = \frac{\cot(\gamma_j) + \cot(\delta_j)}{\left\| \mathbf{p} - \mathbf{q}_j \right\|^2}$$

The weights w_{j-1} and w_{j+1} associated with the other vertices, q_{j-1} and q_{j+1}, are determined in like fashion by applying this formula to the data associated with the respective vertices, q_{j-1} and q_{j+1}.

By way of contrast, in the prior art, a weight w_j for vertex q_j is derived from the product of the area of the triangle 106 (shaded in Figure 1, reproduced below) formed by the three adjacent vertices q_{j+1}, q_j, and q_{j-1} and the areas of the n-2 interior triangles, identified with numerals 108, 110, and 112, formed by the point **p** and the polygon's adjacent vertices (but excluding the two interior triangles that contain the vertex q_j). Mathematically, this formulation may be expressed as follows:

$$w_j = A(\mathbf{q}_{j-1}, \mathbf{q}_j, \mathbf{q}_{j+1}) \bullet \prod_{k \notin \{j, j+1\}} A(\mathbf{q}_{k-1}, \mathbf{q}_k, \mathbf{p})$$

where the function A refers to the area of the triangle whose vertices are the arguments of the function.

This formulation is then repeated for each of the vertices in the polygon. The resulting weights may then be normalized in accordance with the following expression to form the barycentric coordinates for the point **p**:

$$\alpha_j = w_j \Big/ \left(\sum_k w_k \right)$$

This formulation, however, is complex since the computation of the weight corresponding to a particular vertex depends on all the vertices of the polygon, and entails repetitive computations of triangle areas.
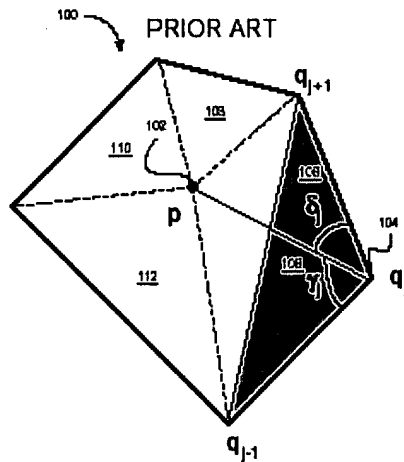
The invention overcomes these problems by allowing the weight w_j, corresponding to the vertex q_j, to be computed based solely on localized data representing the length of the edge pq_j, and the two adjacent angles δ_j and γ_j. Unlike the prior art, the computation of the weight for a particular vertex does not depend on all the vertices of the polygon, or entail repetitive computations of triangle areas. The result is that, unlike the prior art, the weights can be *computed in real time*.

The invention has practical utility in the area of computer graphics, where, in order to conserve storage space, n-sided polygons are often represented in terms of their vertices. When it is time to display the polygon, however, it is necessary to compute in real time a parameter, such as brightness or color, of the interior points of the polygon in terms of the brightness or color of the vertices. The barycentric coordinates are weights that allow the brightness or color of an interior point to be interpolated from the brightness or color of the vertices, *i.e.*, it allows the brightness or color of an interior point to be determined as the weighted sum of the brightness or

color of the vertices. The prior art approach did not allow these weights to be computed in real time. The invention produces a useful, concrete and tangible result by allowing these weights to be computed in real time, which in turn allows the color or brightness of interior points to be interpolated and displayed in real time. This practical application of the invention, *i.e.,* to real time interpolation of interior points of n-sided polygon in the field of computer graphics, is specifically identified in Sections 3.1-3.3 of U.S. Provisional Application 60/267,804, incorporated by reference into the subject application.[2] It is also identified in several publications that were in effect at the time of filing, and that were disclosed to the Patent Office in an IDS. *E.g.,* (a) M. Meyer, et al., "Generalizing Barycentric Coordinates to Irregular N-gons," (b) M. Meyer, et al., "Intrinsic Parameterization of Surface Meshes," (c) Desbrun, et al. "Implicit Fairing of Irregular Meshes Using Diffusion and Curvature Flow," and (d) Eck, et al. "Multiresolution Analysis of Arbitrary Meshes." Thus, the practical utility of the invention is identified in the application itself as well as several publications in effect as of the time of filing.[3]

The transformation of data into a practical useful result such as a final share price, *State Street*, 149 F.3d 1373, a PIC indictor that facilitates differential billing of long-distance calls, *AT&T*, 172 F.3d at 1358, signals representing a patient's heart condition, *Arrhythmia Research Technology, Inc. v. Corazonix Corp.*, 958 F.2d 1053, 1059 (Fed. Cir. 1992), or a smoothed waveform for display on a rasterizer, *In re Alappat*, 33 F.3d 1526 (Fed. Cir. 1994) (en banc), satisfies the requirements of 35 U.S.C. §101. So too here, the transformation of data (representing or associated with the vertices of an n-sided polygon) into weights useful in allowing the brightness or color of an interior point to be interpolated based on the brightness or color of the vertices, having a practical application in computer graphics, satisfies the requirements of 35 U.S.C. §101.

Based on the foregoing, Applicant respectfully requests the Examiner to withdraw the rejection of the claims under 35 U.S.C. §101.

---

[2] These sections specifically identify the practical application of the invention to interpolating scalar and vector fields over n-sided polygons.

[3] It is well established that utility of an invention may be demonstrated by evidence outside the application. *See, e.g. In Re Ferens*, 417 F.2d 1072, 1074 (C.C.P.A. 1969); *In Re Pottier*, 376 F.2d 328, 329-30 (C.C.P.A. 1967); *Fregeau v. Mossinghoff*, 776 F.2d 1034, 1036 (Fed. Cir. 1985).

II. Response to Rejection Of Claims 12-13 Under 35 U.S.C. §101

Claims 12-13 are rejected under §101 for lack of utility, the Examiner stating that it is "unclear what method is embodied" in the claimed memory, and that it is unclear that "such method embodied in a memory can be useful." Applicants respectfully traverse based on the arguments presented above in support of utility, and because the Patent Office now recognizes that computer programs embodied in a tangible medium are patentable subject matter under § 101. *In re Beauregard*, 53 F.3d at 1584.

Claim 14 has been added as depending from claim 13 to claim various forms of computer readable memory. This claim is fully supported in the specification, e.g. at p.10, ln.14-18, and satisfies 35 U.S.C. §101 for the same reasons as claims 12-13.

III. Response to Claim Rejection Under 35 USC §112

The Examiner has also rejected claims 1-13 under 35 USC §112, first paragraph, for lack of enablement based on lack of utility. This rejection should be withdrawn since the practical utility of the invention was apparent to one of ordinary skill in the art as of the time of filing in view of U.S. Provisional Application 60/267,804, incorporated by reference into the subject application, and also several publications, *e.g.,* (a) M. Meyer, et al., "Generalizing Barycentric Coordinates to Irregular N-gons," (b) M. Meyer, et al., "Intrinsic Parameterization of Surface Meshes," (c) Desbrun, et al. "Implicit Fairing of Irregular Meshes Using Diffusion and Curvature Flow," and (d) Eck, et al. "Multiresolution Analysis of Arbitrary Meshes."
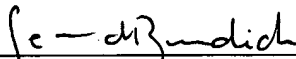
IV. <u>Conclusion</u>

In view of all of the above, Applicants respectfully request that the Examiner withdraw all rejections and pass this Application to issuance.

In papers submitted with this Response, Applicants have authorized the Commissioner to charge the fee set forth under 37 C.F.R. § 1.20(d) for a two-month extension of time. Applicants believe no other fees are due. If any additional fees are in fact due, the Commissioner is hereby authorized to charge Howrey Deposit Account No. **08-3038** for the same referencing Howrey Dkt. No. **01339.0009.NPUS01**.

Respectfully submitted,

Dated: August 23 , 2004

Sean D. Burdick, Reg. No. 51,513

HOWREY SIMON ARNOLD & WHITE, LLP
2941 Fairview Park Drive
Box No. 7
Falls Church, VA 22042
Fax No. (703) 336-6950
Telephone No. (949) 759-5219